

KINGDOM OF SAUDI ARABIA
MINISTRY OF INTERIOR
HIGH COMMISSION FOR INDUSTRIAL SECURITY

SECURITY DIRECTIVES
FOR INDUSTRIAL FACILITIES

SEC-02

Security Fencing



Issue Date: 12/6/1431H / 26/05/2010

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1.0. Administration

1.1. Scope

This Directive provides the minimum requirements for companies and establishments that are subject to the supervision of the High Commission for Industrial Security (HCIS), Ministry of Interior, for fencing requirements at industrial facilities.

1.2. Application

This Directive is applicable to all facilities, including new projects, the expansion of existing facilities, and upgrades. For application to existing facilities, the Operator shall assess his facilities against the requirements of these Directives and coordinate with the General Secretariat of the High Commission for Industrial Security (HCIS) to comply with the Security, Safety, and Fire Protection requirements according to these Directives and add to or modify the existing facilities as required. Where the HCIS has assessed deficiencies in existing facilities during a survey, comparing the current state of the facilities to the requirements of these Directives, those identified deficiencies shall be corrected by the Operator.

1.3. Conflicts & Deviations

Where implementation of a requirement is unsuitable or impractical, where other equivalent company or industry Standards and Codes are followed, or where any conflict exists between this Directive and other company standards and Codes, the deviations shall be resolved by the HCIS. Deviation lower than the requirements of this directive shall be listed and submitted in a report of compliance or non-compliance, with justification and reason, for each applicable requirement of these security directives, and approval shall be received from the HCIS prior to implementation. The documents shall be retained by the company in its permanent engineering files.



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2.0. Definitions

| | |
|------------------|--|
| HCIS | High Commission for Industrial Security. The HCIS is part of the Ministry of the Interior. It is responsible for the development, and implementation, of security, safety and fire protection strategies Kingdom-wide. |
| Operator: | Company or owner of a facility. |
| SD | Security Directives |
| Shall | Indicates a mandatory requirement. |
| Should | Indicates a recommendation or that which is advised but not required. |
| PTZ | Pan-Tilt-Zoom: A method of mounting a surveillance camera that allows it to pan, tilt and zoom while being controlled from a remote location. |
| SCC | Security Control Center: A facility that monitors the complete security environment in a designated area and manages alarms and responses to security events. |

2.1. Terminology

The definition of terms relating to chain link fencing can be found in ASTM F552. The definition of terms relating to barb tape can be found in ASTM F1379.

3.0. References

This directive adopts the latest edition of the references listed.

The selection of material and equipment, and the design, construction, maintenance, operation and repair of equipment and facilities covered by this Security Directive shall comply with the latest edition of the references listed in each Security Directive, unless otherwise noted.



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| | |
|------------------------|--|
| ASTM A121 | Standard Specification for Metallic-Coated Carbon Steel Barbed Wire |
| ASTM A123 | Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A392 | Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric |
| ASTM A641 | Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM C94 | Standard Specification for Ready-Mixed Concrete |
| ASTM F552 | Standard Terminology Relating to Chain Link Fencing |
| ASTM F567 | Standard Practice for Installation of Chain-Link Fence |
| ASTM F626 | Standard Specification for Fence Fittings |
| ASTM F668 | Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric |
| ASTM F934 | Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials |
| ASTM F1043 | Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework |
| ASTM F1083 | Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures |
| ASTM F1379 | Standard Terminology Relating to Barbed Tape |
| ASTM F1664 | Standard Specification for PolyVinyl Chloride(PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence |
| ASTM F1910 | Standard Specification for Long Barbed Tape Obstacles |
| ASTM F1911 | Standard Practice for Installation of Barbed Tape |
| ASTM F2656-07 | Test method for vehicle crash testing of perimeter barriers |
| BS PAS-68: 2010 | BS PAS 68:2010, Specification for vehicle security barriers |



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4.0. General Requirements

4.1. Introduction

The perimeter of facilities shall be protected by a fence system in accordance with the requirements stated in this Security Directive.

- 4.1.1. The type of fence used in a facility shall be based on the facility classification as defined and specified in SEC-01 “Application of Security Directives”.
- 4.1.2. This Security Directive defines fences and emergency gates in fences. There are four distinct fence types numbered Category 1 through Category 4. Category 1 fences provide the highest security while Category 4 fences are designated for lower security requirements.
- 4.1.3. The fence is defined in terms of functional aspects followed by specific details of fence material requirements and installation requirements.
- 4.1.4. Any gates or openings in the perimeter fence shall meet the requirements of SEC-03.

4.2. Fence Definition Methodology

The following functions are combined to produce a specific category type fencing system.

- 4.2.1. The functions constituting the fencing system are as follows:

- 4.2.1.1. *External Interface - Encompasses the requirements external to the fence and generally consists of patrol roads and associated clearances.*
- 4.2.1.2. *Anti-Personnel Barrier - Describes the components that provide anti-personnel characteristics of the fencing system.*
- 4.2.1.3. *Anti-Vehicle Barrier - Describes the components that provide physical impediments to vehicle ingress through the fencing system.*
- 4.2.1.4. *Intrusion Sensors / Surveillance Layer - Defines the installation environments for electronic, fence mounted, sensing systems & volumetric sensors that comply with the requirements of SEC-*



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05 "Integrated Security System" for detection of attempts to cut or climb the fence or penetrate the fencing system.

- 4.2.1.5. Lighting - Describes the requirements for perimeter and shared fence lighting as defined in SEC-04 "Lighting".
- 4.2.1.6. Internal Interface - Encompasses the requirements internal to the fence and generally consists of patrol roads and associated clearances on the inside of the perimeter.
- 4.2.2. While the description is provided in terms of discrete, functional layers, these discrete functions are physically combined to achieve the specified functionality. All functions shall be installed contiguous to each other or may be co-located depending on specific fence configuration.
- 4.2.3. All areas where SEC-02 required elements are installed shall be graded and cleared of all vegetation and maintained in this state. The clear zone shall have a 2% slope, away from the facility, to ensure proper water drainage.
- 4.2.4. The requirements for each layer are summarized in the following sections followed by specific fence material and installation requirements in the Design Detail Section.
- 4.2.5. Drawings for all fence elements are shown in section 5.0 of this security directive.

4.3. Category 1 Fencing System

Category 1 fencing systems are used at facilities where the highest level of security is required. Category 1 fences implement a layered approach to security consisting of an external interface layer, anti-vehicle layer, anti-personnel layer, intrusion sensor layer, lighting layer and an internal interface layer.

Isometric & elevation drawings of the fencing system are shown in figures 1 & 2.

Each layer is defined below.

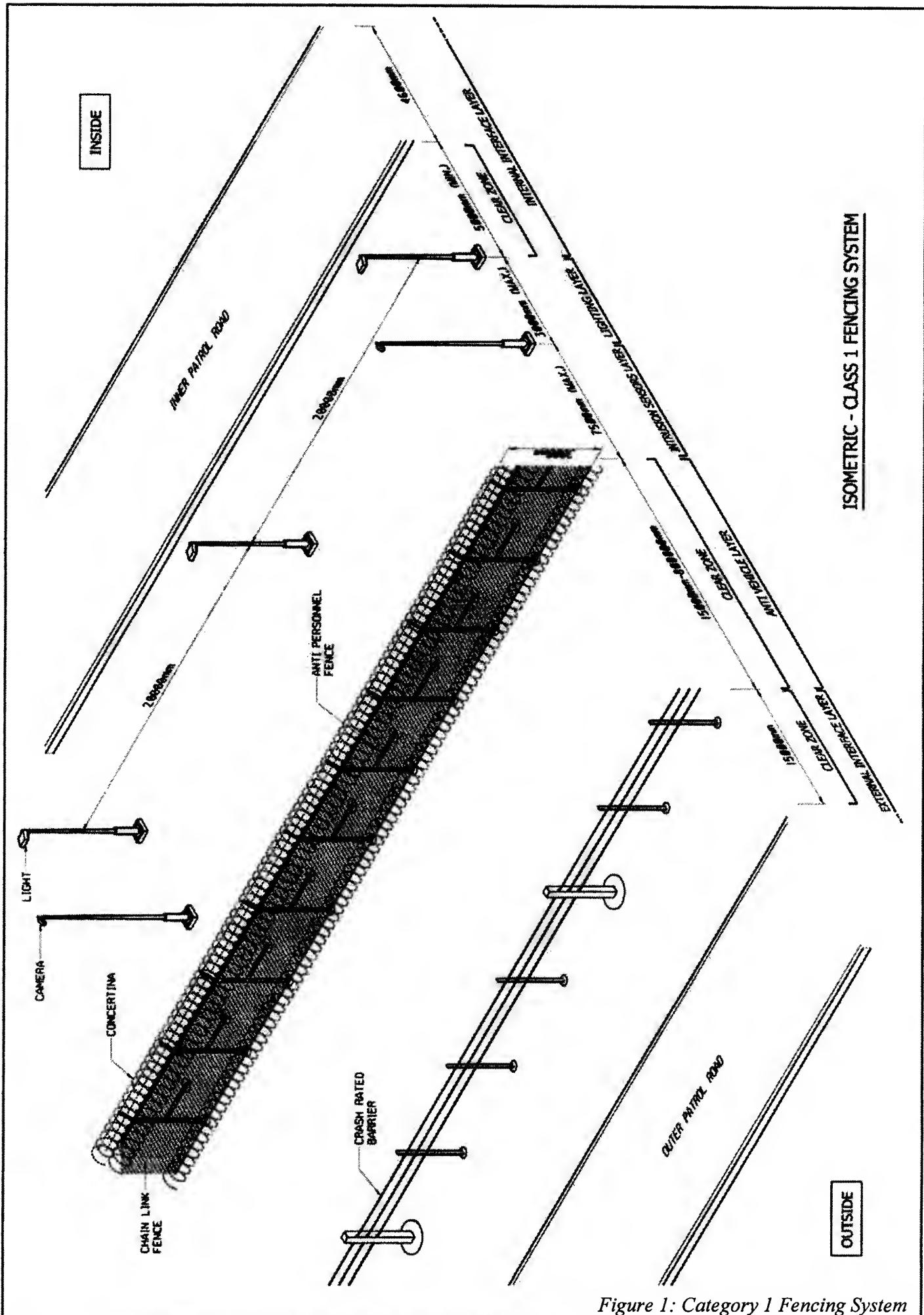


Figure 1: Category 1 Fencing System

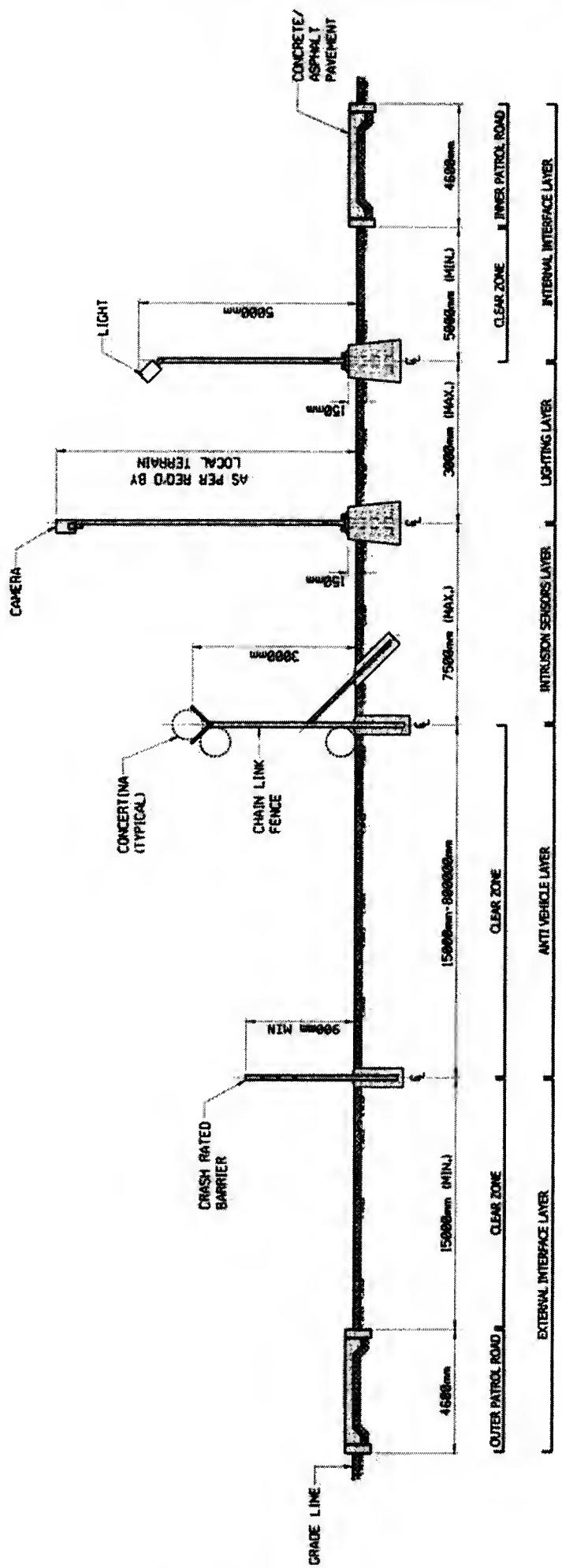


Figure 2: Category 1 Fencing System



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4.3.1. Category 1 External Interface Layer

The Category 1 fencing system requires an external interface layer comprised of an outer patrol road and required clear zones. The external interface describes the requirements external to the fencing system.

This outer patrol road is used by security personnel to patrol the perimeter from the outside. It must be level, a minimum of 4.6m wide and paved (concrete or asphalt) to ensure road is passable under all weather conditions.

This clear zone for this area refers to an area, on the outside of the fencing system, cleared of all vegetation & obstructions, and maintained in this state. This clear zone, measured as the distance from the anti-vehicle barrier (*see next section*), on the outside of the fencing system, shall be at least 15m wide. The patrol road shall be located within this clear zone.

4.3.2. Category 1 Anti-Vehicle Layer

The Category 1 fencing system requires an anti-vehicle layer comprised of a crash rated barrier and associated clear zone. The anti-vehicle layer is contiguous to the inside of the external interface layer.

The anti-vehicle layer consists of a crash-rated barrier that meets or exceeds the requirements of ASTM F2656 M50-P1, or its equivalent in BS PAS-68, as stated in SEC-06. The barrier shall be non-obscuring to allow perimeter monitoring and assessment systems to have a clear field of view.

If terrain, or other considerations, allow use of a lower rated crash barrier the concurrence of HCIS must be obtained to use a lower rated barrier as specified in SEC-06. Where the terrain, and/or distance, allows acceleration to the maximum speed listed in ASTM F2656, the crash-rated barrier shall be rated at the maximum rating (M50-P1 in ASTM F2656 as an example).

The clear zone associated with this layer will extend 800m-15m inside the anti-vehicle barrier. The 800m clearance is required when the surrounding area is vacant at the time the facility is designed and constructed while 15m is the minimum clearance.



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4.3.3. Category 1 Anti-Personnel Layer

The Category 1 fencing system requires an anti-personnel layer contiguous with the anti-vehicle layer clear zone. The anti-personnel fence shall consist of a 3m high fence configured with three rolls of concertina wire. The concertina wire shall be mounted on top of the fence with a second roll mounted on the front top and the third roll mounted on the bottom. The details of the fence installation can be found in the Design Details section of this Security Directive.

Each pole on the anti-personnel fence will be reinforced by bracing each pole with a brace post, on the inside, attached at a point 1500mm above the ground plane and extending downwards towards the inside of the fence at 45° in the vertical plane which is perpendicular to the plane of the fence. The details of the brace posts can be found in the Design Details section of this Security Directive.

4.3.4. Category 1 Intrusion Sensors Layer

The Category 1 fencing system requires intrusion sensors to detect any attempt at entering the facility through the fencing system. The sensors shall incorporate at least two types of sensing technologies in order to provide a high level of probability of detection of an unauthorized penetration attempt. These sensors shall work in an integrated environment to detect such intrusions and shall be mounted as needed in the area inside the anti-personnel fence.

At least one of the sensors shall be capable of detecting vertical and lateral movement within the field.

Cameras mounted for assessment or as a sensor shall supply video imagery of the fencing system. The Video Assessment system shall detect intrusions within the camera's field of view. The field of view for the camera shall be designed so as to provide an uninterrupted view up to the next camera. Cameras shall be located at a maximum distance of 7.5m from the inside of the anti-personnel fence.

Intrusion sensors & cameras shall meet the requirements stated in SEC-05 "Integrated Security System".



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These cameras shall be sited to provide a clear view of the perimeter and with adequate zoom capability to discern facial features of an intruder within the monitored area or zone.

4.3.5. Category 1 Lighting Layer

The Category 1 fencing system shall include a lighting layer fully compliant with SEC-04 “Security Lighting”. The lighting shall typically be installed a maximum of 3m behind the camera pole location.

Lights shall be installed to be out of the field of view of the assessment cameras.

4.3.6. Category 1 Internal Interface Layer

The Category 1 fencing system requires an internal interface layer comprised of required clear zones and an inner patrol road. The internal interface describes the requirements internal to the fencing system.

This clear zone for this area refers to an area, on the inside of the fencing system, cleared of all vegetation & obstructions, and maintained in this state. This clear zone, measured as the distance from the lighting pole, shall be at least 5m wide.

This inner patrol road is used by security personnel to patrol the perimeter from the inside. It must be level, a minimum of 4.6m wide and paved (concrete or asphalt) to ensure road is passable under all weather conditions. It shall be located at the edge of the internal interface clear zone.

4.4. Category 2 Fencing System

Category 2 fencing systems are used at facilities where high levels of security are required. Category 2 fences implement a layered approach to security consisting of an external interface layer, anti-personnel layer, anti-vehicle layer, intrusion sensor layer, lighting layer and an internal interface layer.

Isometric & elevation drawings of the fencing system are shown in figures 3 & 4.

Each layer is defined below.



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4.4.1. Category 2 External Interface Layer

The Category 2 fencing system requires an external interface layer comprised of an outer patrol road and required clear zones. The external interface describes the requirements external to the fencing system.

This outer patrol road is used by security personnel to patrol the perimeter from the outside. It must be level, a minimum of 4.6m wide and paved (concrete or asphalt) to ensure road is passable under all weather conditions.

This clear zone for this area refers to an area, on the outside of the fencing system, cleared of all vegetation & obstructions, and maintained in this state. This clear zone, measured as the distance from the inner edge of the patrol road to the Anti-Personnel fence (see next section), shall be 15m wide.

4.4.2. Category 2 Anti-Personnel Layer

The Category 2 fencing system requires an anti-personnel layer comprised of an anti-personnel fence and associated clear zone. The anti-personnel layer is contiguous on the inside of the external interface layer.

The anti-personnel barrier consists of a 3m high fence configured with three rolls of concertina wire. The concertina wire shall be mounted on top of the fence with a second roll mounted on the front top and the third roll mounted on the bottom. The details of the fence can be found in the Design Details section of this Security Directive.

The clear zone associated with this layer will extend 10.5m inside the anti-personnel fence. This clear zone will house sensors for intrusion detection.

4.4.3. Category 2 Anti-Vehicle Layer

The Category 2 fencing system requires an anti-vehicle layer comprised of fence reinforcements. The anti-vehicle layer is co-located with the antipersonnel fence.

Each pole on the anti-personnel fence will be reinforced by bracing each pole with a brace post, on the inside, attached at a point 1500mm above the ground plane and extending downwards towards the inside of the fence at 45° in the vertical plane which is perpendicular to the plane of the fence.

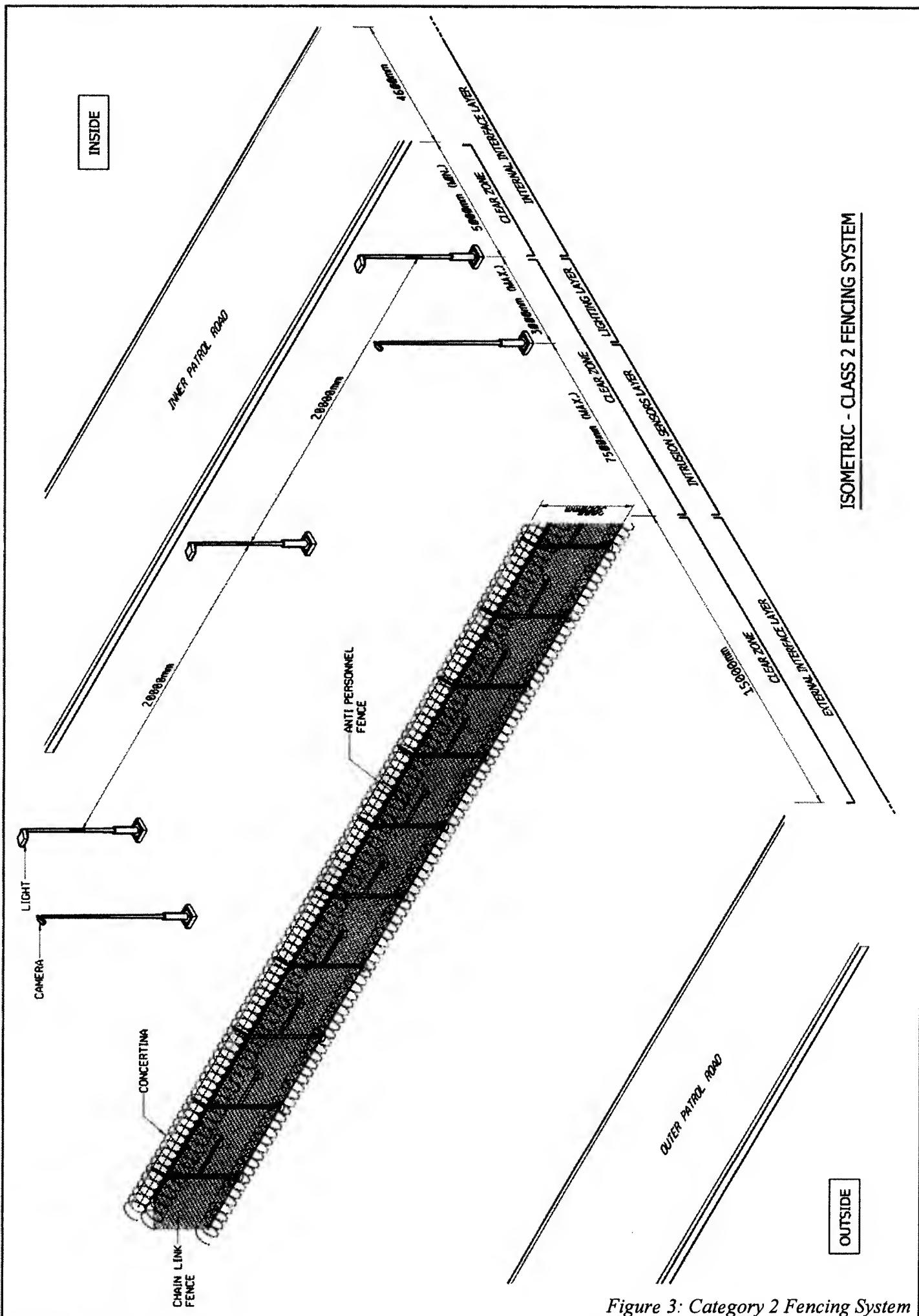


Figure 3: Category 2 Fencing System

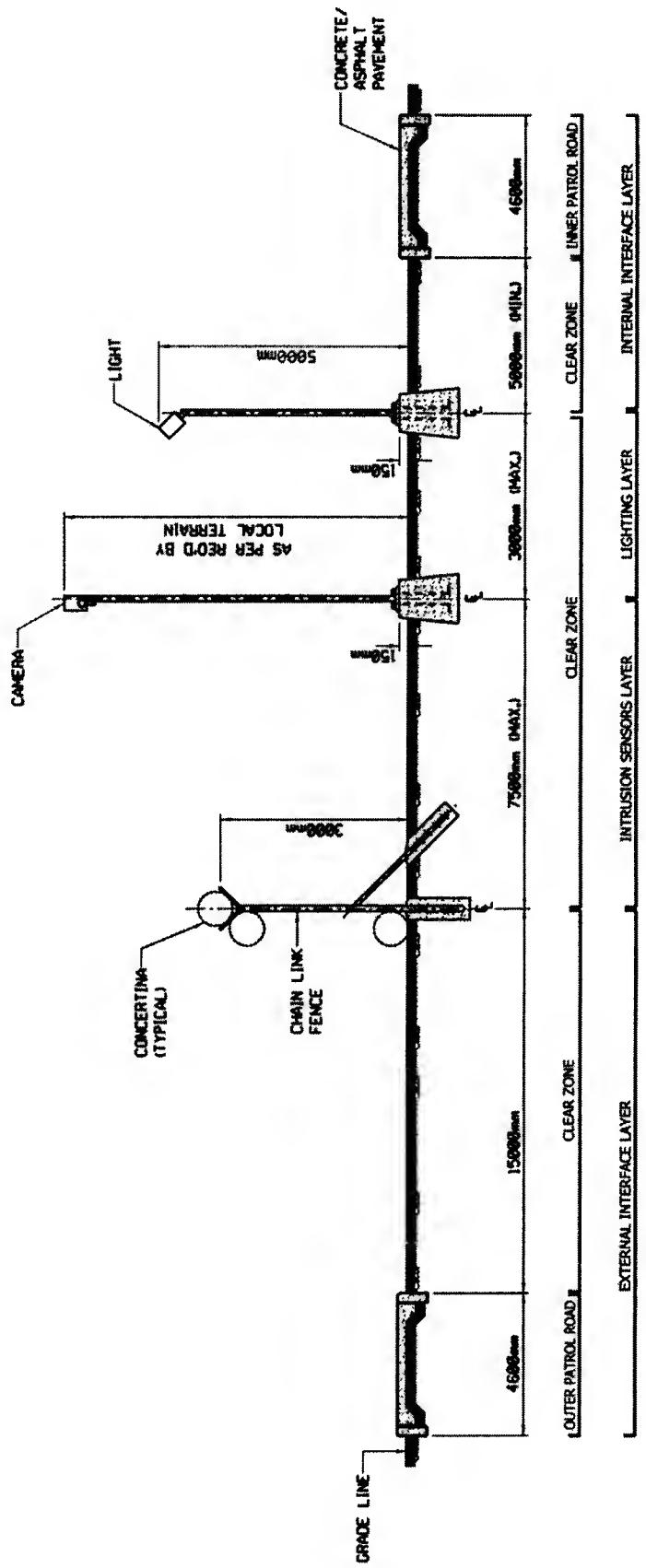


Figure 4: Category 2 Fencing System



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The details of the brace posts can be found in the Design Details section of this Security Directive. Lateral bracing, or other measures, may be added to increase the anti-personnel fence to increase anti-vehicle characteristics.

The Operator shall, in consultation with HCIS, add additional anti-vehicle barriers, such as cable based or crash rated fences if required by the risk analysis or HCIS. In all circumstances anti-personnel requirements and clearances shall be retained.

4.4.4. Category 2 Intrusion Sensors Layer

The Category 2 fencing system requires intrusion sensors to detect any attempt at entering the facility through the fencing system. The sensors shall incorporate at least two types of sensing technologies in order to provide a high level of probability of detection of an unauthorized penetration attempt. These sensors shall work in an integrated environment to detect such intrusions and can be mounted as needed in the inside area of the anti-personnel fence.

At least one of the sensors shall be capable of detecting vertical and lateral movement within the field.

Cameras mounted for assessment or as a sensor shall supply video imagery of the fencing system. The Video Assessment system shall detect intrusions within the camera's field of view. Cameras shall be located at a maximum distance of 7.5m from the inside of the anti-personnel fence.

Intrusion sensors & cameras shall meet the requirements stated in SEC-05 "Integrated Security System".

These cameras shall be sited to provide a clear view of the perimeter and with adequate zoom capability to discern facial features of an intruder within the monitored area or zone.

4.4.5. Category 2 Lighting Layer

The Category 2 fencing system shall include lighting layer fully compliant with SEC-04 "Lighting". The lighting shall typically be installed a maximum of 3m behind the camera pole location.

Lights shall be installed to be out of the field of view of the assessment cameras.



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4.4.6. Category 2 Internal Interface Layer

The Category 2 fencing system requires an internal interface layer comprised of required clear zones and an inner patrol road. The internal interface describes the requirements internal to the fencing system.

This clear zone for this area refers to an area, on the inside of the fencing system, cleared of all vegetation & obstructions, and maintained in this state. This clear zone, measured as the distance from the lighting pole, shall be at least 5m wide.

This inner patrol road is used by security personnel to patrol the perimeter from the inside. It must be level, a minimum of 4.6m wide and paved (concrete or asphalt) to ensure road is passable under all weather conditions. It shall be located at the edge of the internal interface clear zone.

4.5. Category 3 Fencing System

Category 3 fencing systems are used at facilities where medium levels of security are required. Category 3 fencing systems implement a layered approach to security consisting of an external interface layer, anti-personnel layer, anti-vehicle layer, lighting layer, surveillance layer, and an internal interface layer.

Isometric & elevation drawings of the fencing system are shown in figures 5 & 6.

Each layer is defined below.

4.5.1. Category 3 External Interface Layer

The Category 3 fencing system requires an external interface layer comprised of a required clear zone. The external interface describes the requirements external to the fencing system.

This clear zone for this area refers to an area, on the outside of the fencing system, cleared of all vegetation & obstructions, and maintained in this state. This clear zone, measured as the distance outside the Anti-Personnel fence, (see next section), shall be at least 6m wide.

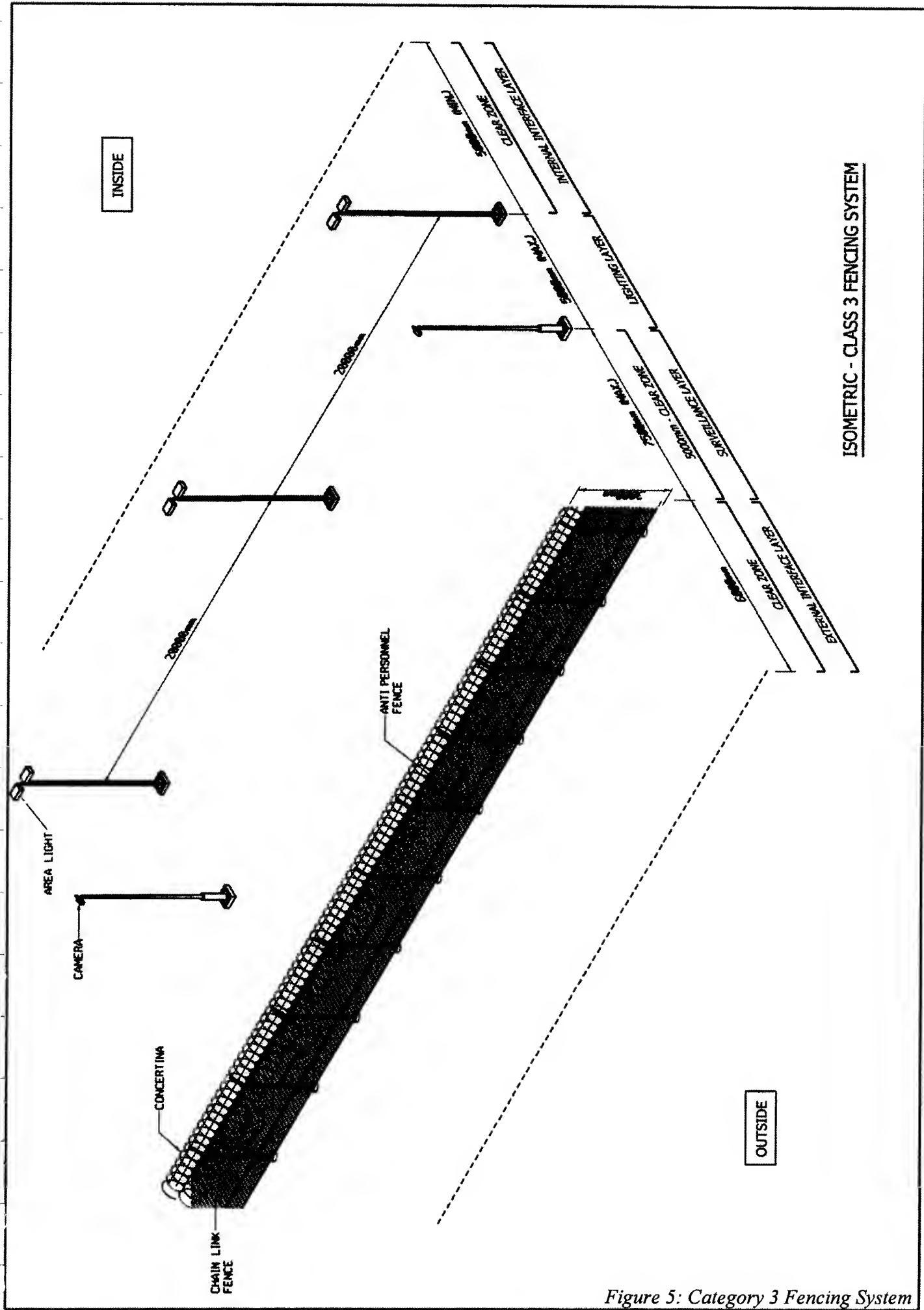
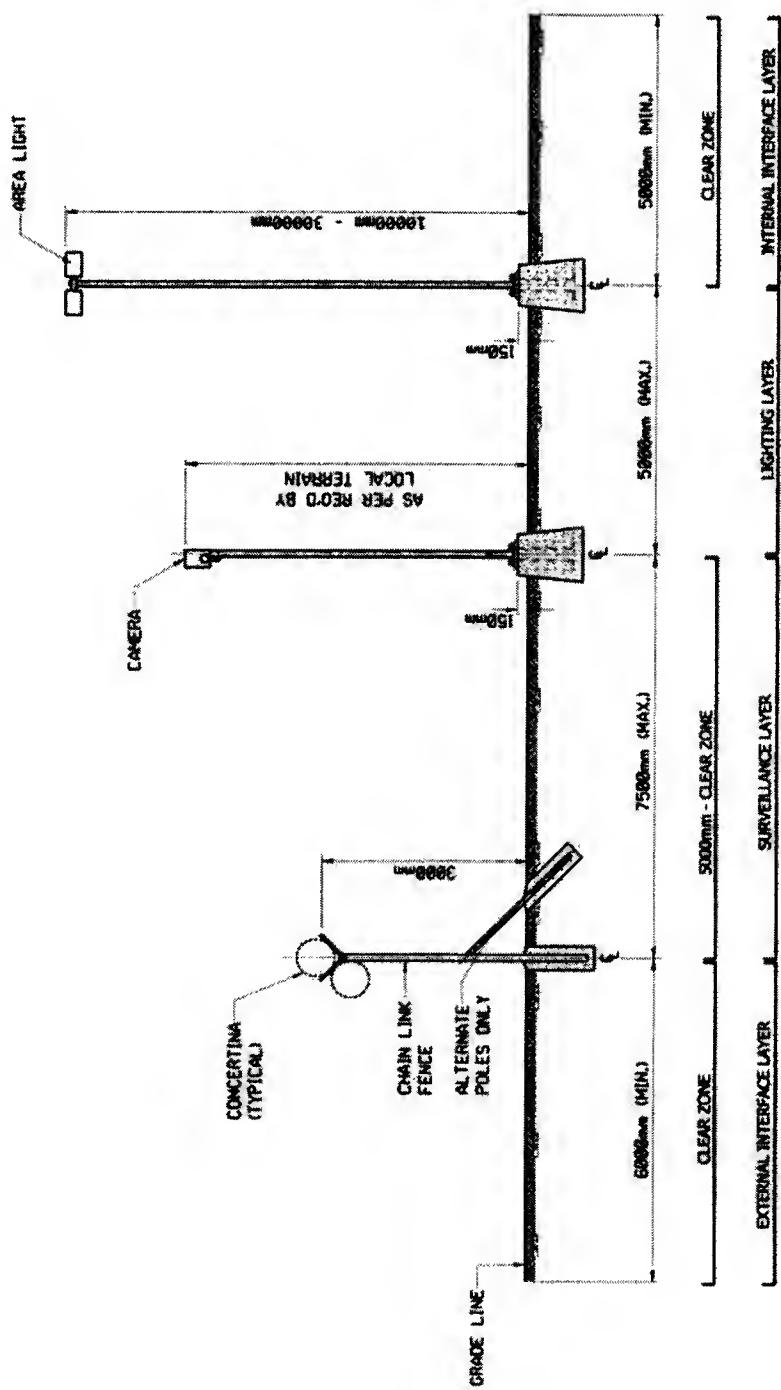


Figure 5: Category 3 Fencing System



ELEVATION - CLASS 3 FENCING SYSTEM

Figure 6: Category 3 Fencing System



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4.5.2. Category 3 Anti-Personnel Layer

The Category 3 fencing system requires an anti-personnel layer comprised of an anti-personnel fence and associated clear zone. The anti-personnel layer is contiguous to the external interface layer.

The anti-personnel barrier consists of a 3m high fence configured with two rolls of concertina wire. The concertina wire shall be mounted on the front top and the second roll mounted on the top. The details of the installation can be found in the Design Details section of this Security Directive.

The clear zone associated with this layer will extend 5m inside the anti-personnel fence.

4.5.3. Category 3 Anti-Vehicle Layer

The Category 3 fencing system requires an anti-vehicle layer comprised of fence reinforcements co-located with the anti-personnel fence.

Each alternate pole on the anti-personnel fence will be reinforced by bracing each pole with a brace post, on the inside, attached at a point 1500mm above the ground plane and extending downwards towards the inside of the fence at 45° in the vertical plane which is perpendicular to the plane of the fence. The details of the brace posts installation can be found in the Design Details section of this Security Directive.

4.5.4. Category 3 Surveillance Layer

The Category 3 fencing system shall include a Surveillance layer fully compliant with SEC-05 “Integrated Security System”. Surveillance cameras can be selected at Operator discretion and may be fixed or Pan/Tilt/Zoom (PTZ) types. These cameras shall be sited to provide a clear view of the perimeter and with adequate zoom capability to discern facial features of an intruder within the monitored area or zone.

Cameras shall be located at a maximum distance of 7.5m from the inside of the anti-personnel fence.



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4.5.5. Category 3 Lighting Layer

The Category 3 fencing system shall include an Area lighting layer fully compliant with SEC-04 “Lighting”. The lighting shall typically be installed a maximum of 5m behind the camera pole location.

Lights shall be installed to be out of the field of view of the assessment cameras.

4.5.6. Category 3 Internal Interface Layer

The internal interface describes the requirements internal to the fencing system. The Category 3 fencing system requires an internal interface layer comprised of a clear zone.

This clear zone for this area refers to an area, on the inside of the fencing system, cleared of all vegetation & obstructions, and maintained in this state. This clear zone, measured as the distance from the fence towards the inside of the facility, shall be at least 5m wide.

4.6. Category 4 Fencing System

Category 4 fencing systems are used at facilities where low levels of security are required. Category 4 fencing systems implement a simple approach to security consisting of an anti-personnel layer with associated internal and external clear zones.

The anti-personnel function is provided by a 3m high fence with a single roll of concertina wire mounted on outriggers along the top of the fence. Fence bracing shall be at operator discretion. The fence perimeter should have at least a 5m clear zone on the inside and outside of the fence. Lighting is at Operator discretion but Area lighting is recommended. The lighting can be located within the inner clear zone if required.

Isometric and elevation drawings of the fencing system are shown in figures 7 & 8.

The details of the fence installation can be found in the Design Details section of this Security Directive.

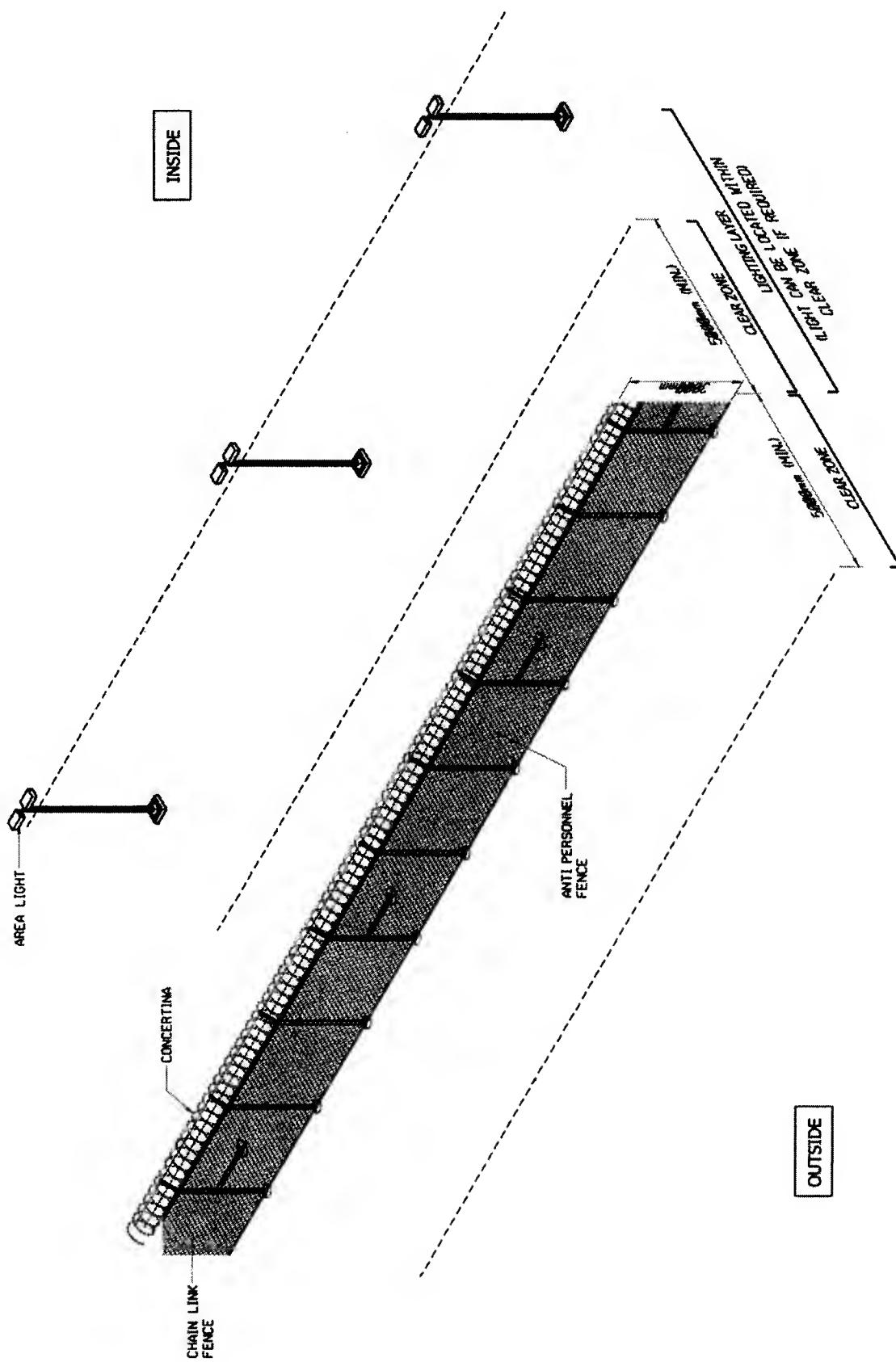
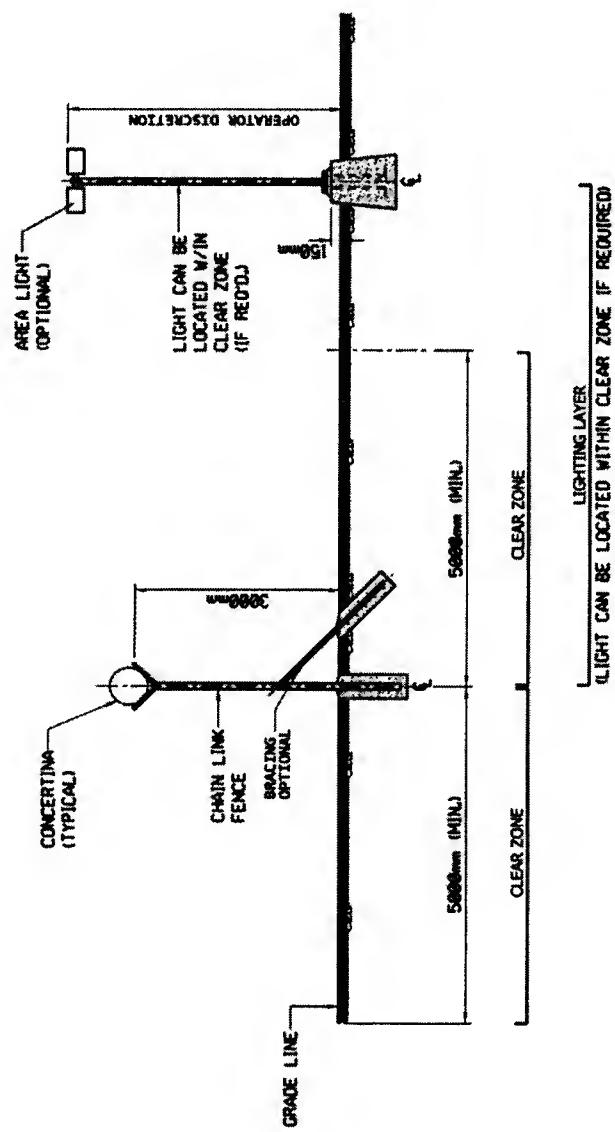


Figure 7: Category 4 Fencing System



ELEVATION - CLASS 4 FENCING SYSTEM

Figure 8: Category 4 Fencing System



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4.7. Shared Fencing Between Adjacent Facilities

Adjacent facilities present a special case for fencing. As a general rule, the first facility that is being constructed shall implement all fences, clearances and clear zones. Facilities built after the first facility is built shall implement a modified version of the requirements.

Lighting shall comply with the requirements stated in SEC-04 “Lighting” for Shared Fence Lighting. Camera and sensor locations for each category fence shall be modified so that they minimize interaction between adjacent security systems.

A clear zone of 5m shall be established between the shared fence and the new facility. This clear zone shall house sensors as needed by the fence category. All remaining clearances for that particular fence category shall remain.

An overview of a shared fence is shown in figure 9.

These requirements shall apply to facilities classified as category 1, 2 or 3.

4.8. Outer Property Fence

Outer property fences located remotely from a class 1, 2 or 3 facility present a special case for fencing. When a facility has an outer property fence that surrounds a class 1, 2 or 3 facility or facilities, the outer property fence shall be a category 4 fence with an inner and outer patrol road.

This fence shall be considered an administrative fence and it shall not impact the fencing systems used around the class 1, 2 or 3 facilities located within the property fence which will continue to comply with all applicable standards.

4.9. Clearances - General

Adjacent Refers to the minimum distance, including the clear zone, inside the inner fence, at which Class 1, 2, 3, & 4 facilities may be located.

Clearances to the nearest critical element within the facility shall be located as shown below. Critical elements located with the facility are items such as, but not

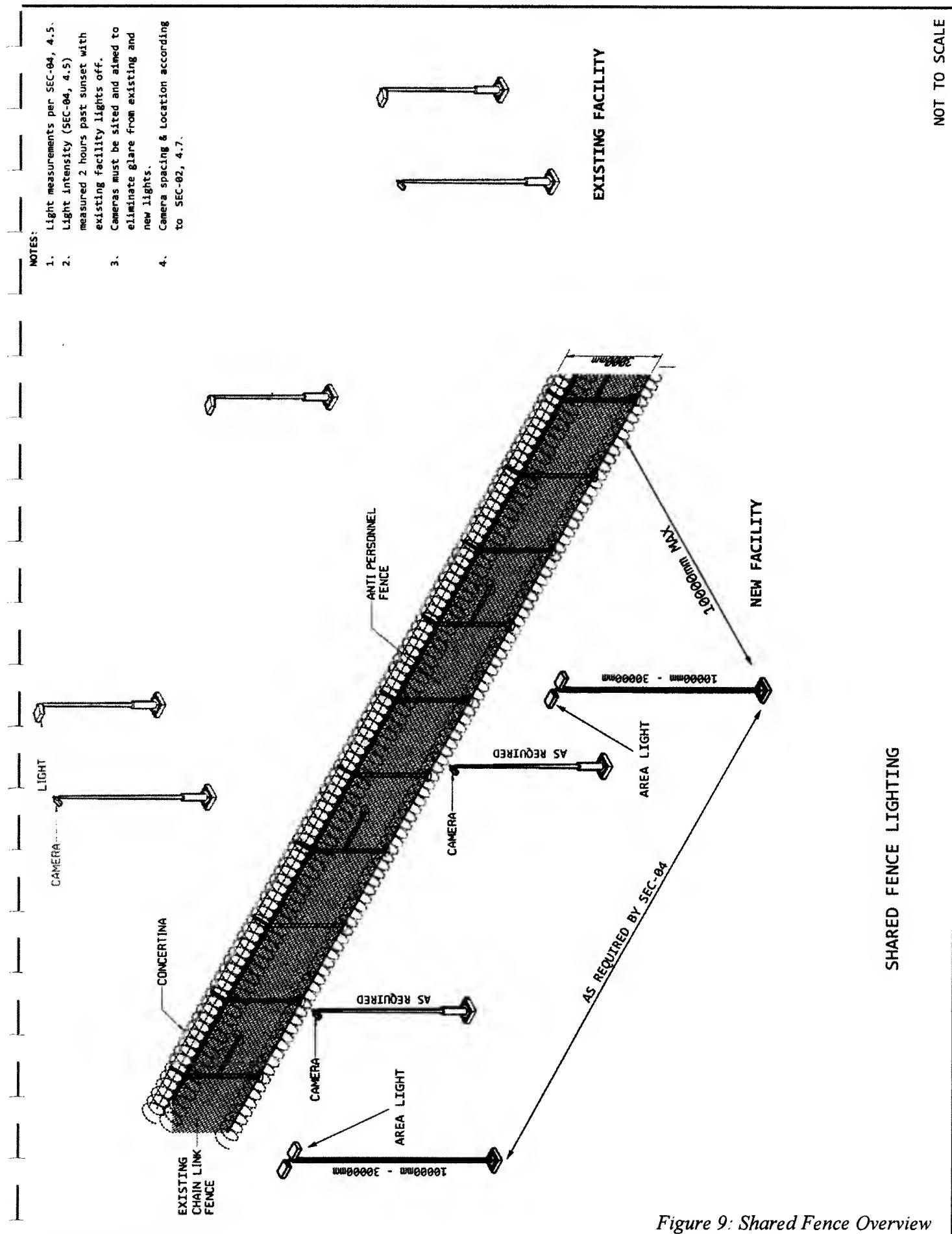


Figure 9: Shared Fence Overview

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limited to, main electrical facilities, storage tanks (non water), pump stations, control rooms and processing facilities. Operator shall determine critical elements needed for the facility and ensure clearances are complied with. HCIS shall have the right to designate elements to comply with clearance requirements.

| | | |
|-------------|-----------------------------|-------------------------------|
| Category 1: | 60m | <i>Critical elements only</i> |
| Category 2: | 60m | <i>Critical elements only</i> |
| Category 3: | 60m | <i>Critical elements only</i> |
| Category 4: | As required by the Operator | |

These clearances apply to the distance that critical elements are located from the fence. This does not apply to non-critical elements which can be located closer to the fence as long as safety and building codes are complied with.

4.9.1. Clearances - Coastal Facility

If facility is built in coastal areas the following additional requirements apply.

Coastal facility clearance refers to the minimum distance, in front of the anti-personnel barrier, to the high water mark.

This distance shall be 60m which will include outer patrol road clearances.

4.9.2. Clearances - Elevated Pad

If facility is built on an elevated pad, 1.5m or higher, the following additional requirements apply.

The requirements shall be maintained as shown in Table 1, please note that distances include clear zones:

| Requirement | Category 1 | Category 2 | Category 3 | Category 4 |
|--|--------------|------------|------------|------------|
| Clearance; Toe of berm to fence | 30m | 30m | 20m | 20m |
| Slope; Toe of berm to fence | 0.3m in 30m | | | |
| Slope; Fence to distance outside the fence | 0.3m in 6.1m | | | |

Table 1 – Elevated Pad clearances



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4.10. Main Gates

Main gates shall be configured as specified in SEC-03 “Gatehouse Architecture”.

4.11. Emergency/Heavy Equipment Gates

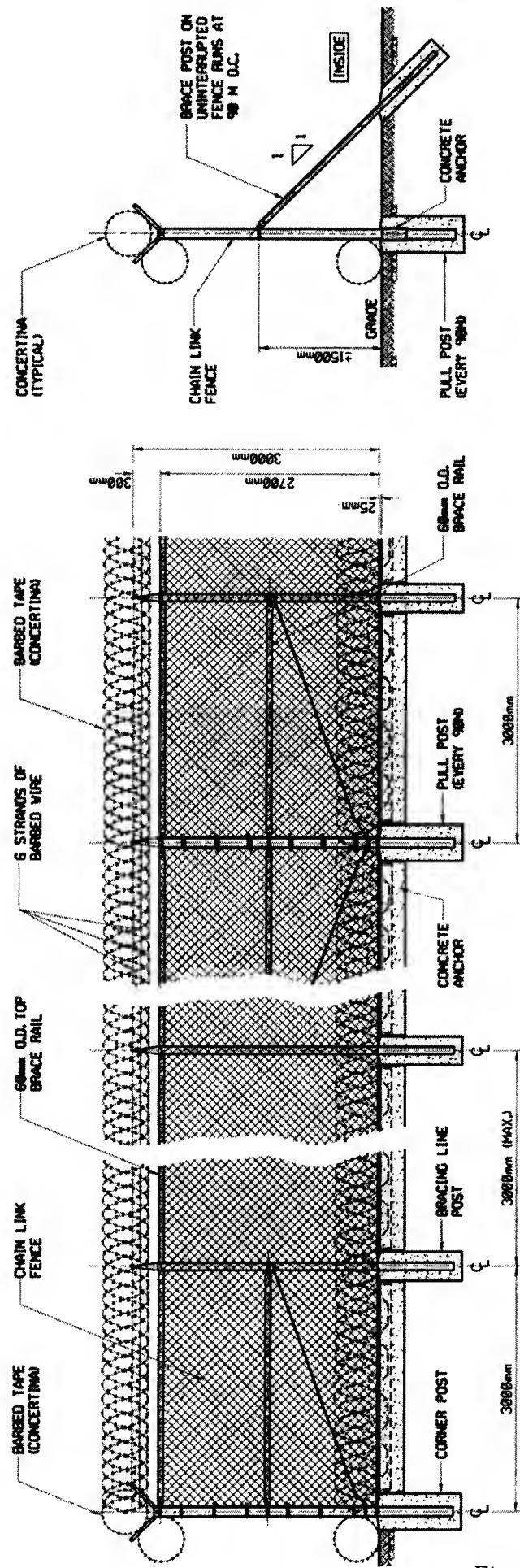
- 4.11.1. Emergency gates in the perimeter shall meet the requirements of ASTM F2656 or BS PAS-68 for anti-vehicle barriers as specified in SEC-06. This compliance may be accomplished by a combination of anti-personnel barriers and anti-vehicle barriers depending on the operators design.
- 4.11.2. Operator shall implement a maintenance program for monthly testing of each gate.
- 4.11.3. Emergency gates shall have video surveillance that is monitored in the local SCC.
- 4.11.4. Gate width shall be at least 5m, or greater, if needed due to operational requirements.
- 4.11.5. Emergency gates shall have the same anti-personnel characteristics as the rest of the perimeter fencing.

4.12. Design Requirements for Fencing System Components

Details and drawings of individual design elements are shown in this section. A general layout of a chain link fence is shown in figure 10.

4.12.1. Materials

Materials shall be uniform and consistent and shall meet the following requirements:



GENERAL LAYOUT - CHAIN LINK SECURITY FENCE
SCALE 1:500H

Figure 10: Chain Link Fence Overview



4.12.2. Fabric

4.12.2.1. Fabric shall be vinyl-coated chain link with a 50 mm diamond mesh and a height of 2700 mm (± 12 mm), with the top selvages twisted and the bottom selvage is a knuckle. The standard length of roll shall be 15m, or greater, and shall be woven continuously without splices.

Exception:

Galvanized fabric shall be permitted when required by section 4.13.8 or when needed for fence sensor performance.

4.12.2.2. Vinyl-coated chain link fabric shall be PVC fusion bonded fabric per ASTM F668, Class 2b and shall consist of 9-gage (4.00 mm in diameter) core wires uniformly galvanized in accordance with ASTM A641, Class I, and coated with 0.20 mm (8 mil) of PVC applied by the fusion method over a thermo set plastic bonding agent. Up to 6-gage wire may be used for the fence fabric if selected by the Operator.

4.12.2.3. The minimum breaking strength for the fence fabric shall be 9650 N (2170 lbs).

4.12.2.4. The color of the PVC shall be dark green or black as per ASTM F934.

4.12.2.5. If galvanized fabric is used, as required in 4.12.8., it shall consist of heavy galvanized chain link material, conforming to ASTM A392, Class II, 2-inch (50-mm) mesh 9-gage wire and a height of 2700 mm (± 12 mm). Up to 6-gage wire may be used for the fence fabric if selected by the Operator.

4.12.3. Line Posts

4.12.3.1. Line posts shall be NPS 3 schedule 80 steel pipe (OD = 89 mm [3.5 inch]), high strength 83,000 grade (minimum tensile strength shall be 585 MPa [85,000 psi] and minimum yield strength shall be 572 MPa [83,000 psi]) as per *ASTM F1083* Group 1A, galvanized internally and externally in accordance with Type A of *ASTM F1043*.

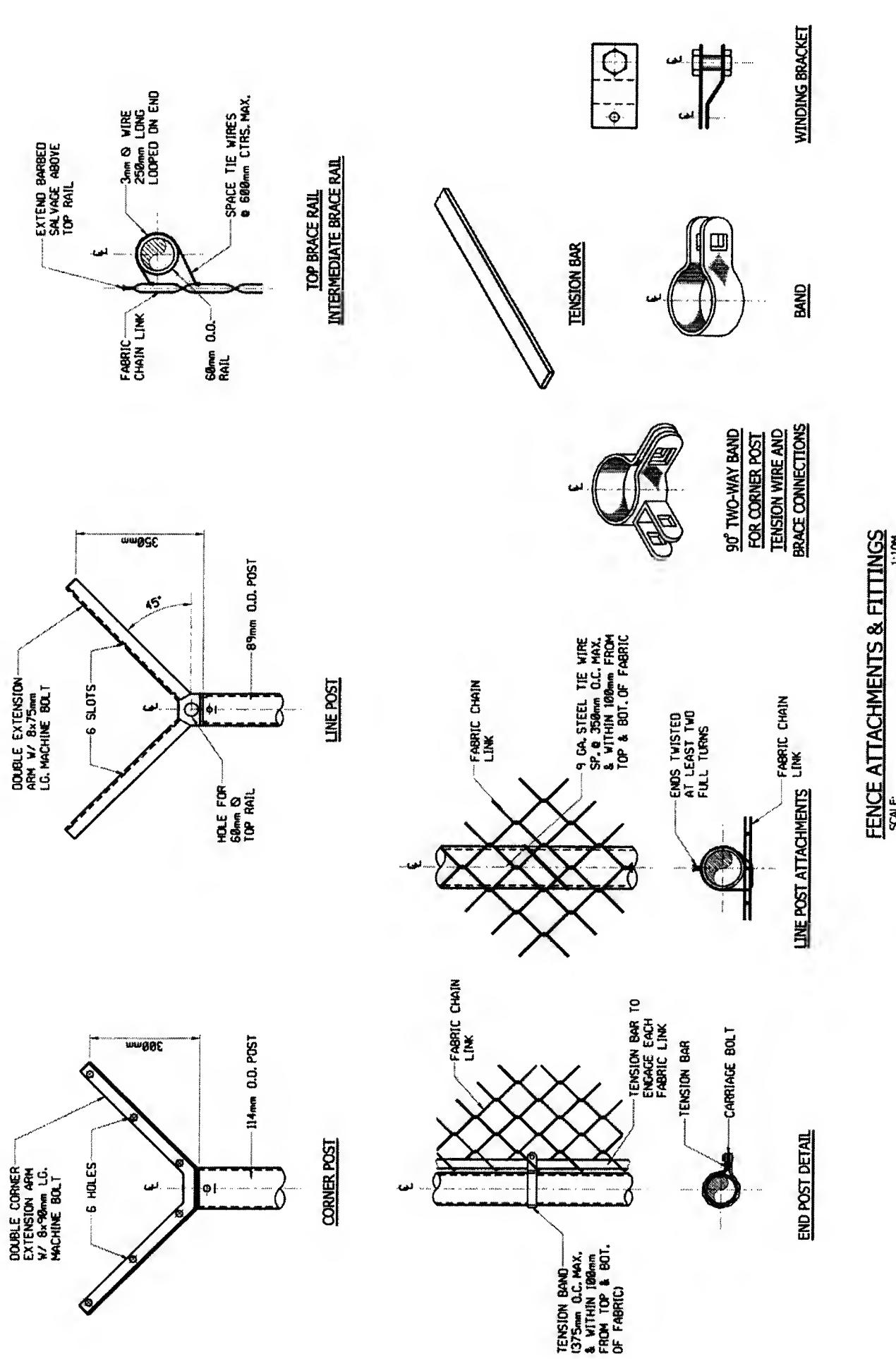


Figure 11: Fence Fittings

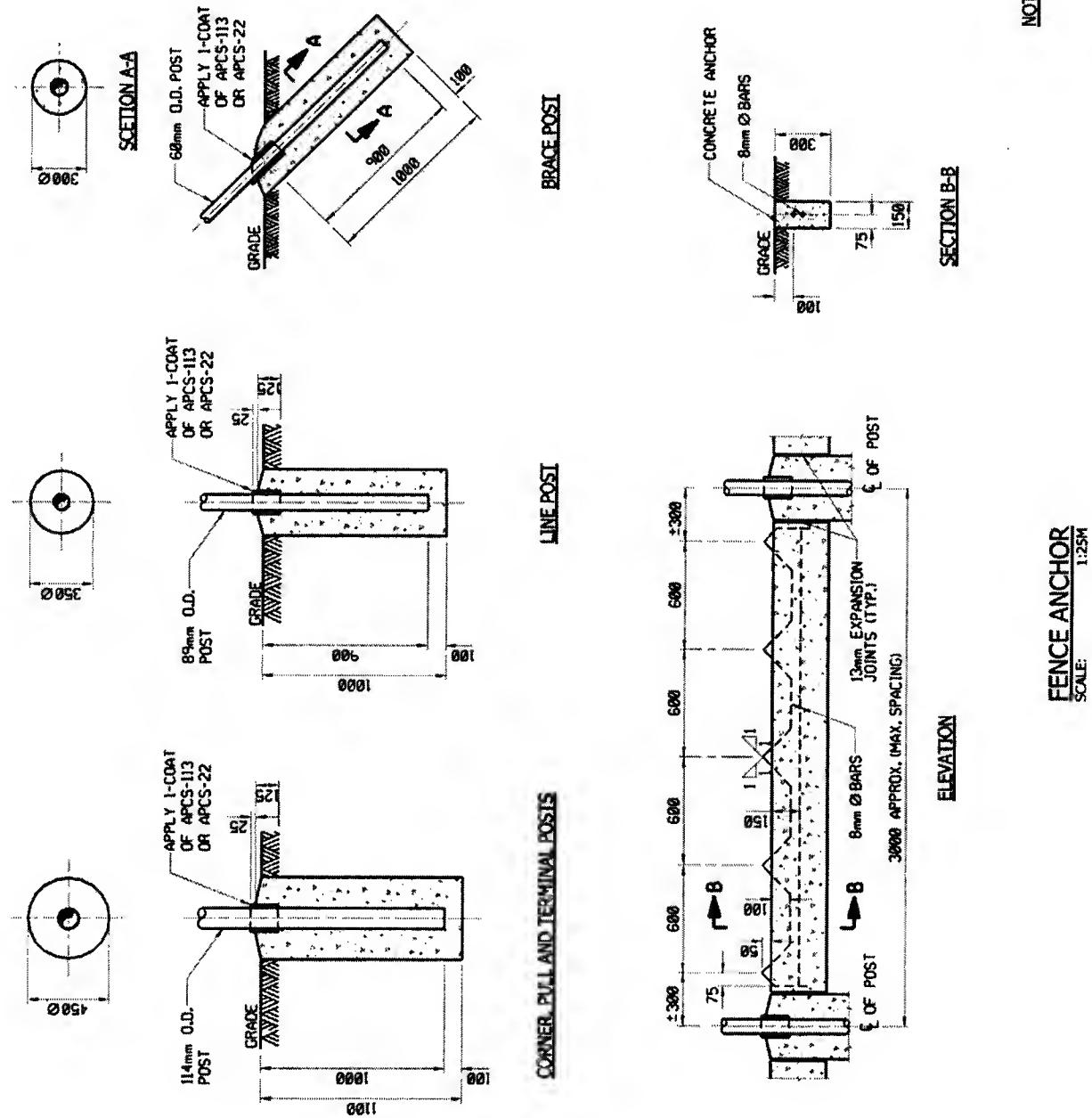


Figure 12: Fence Anchors

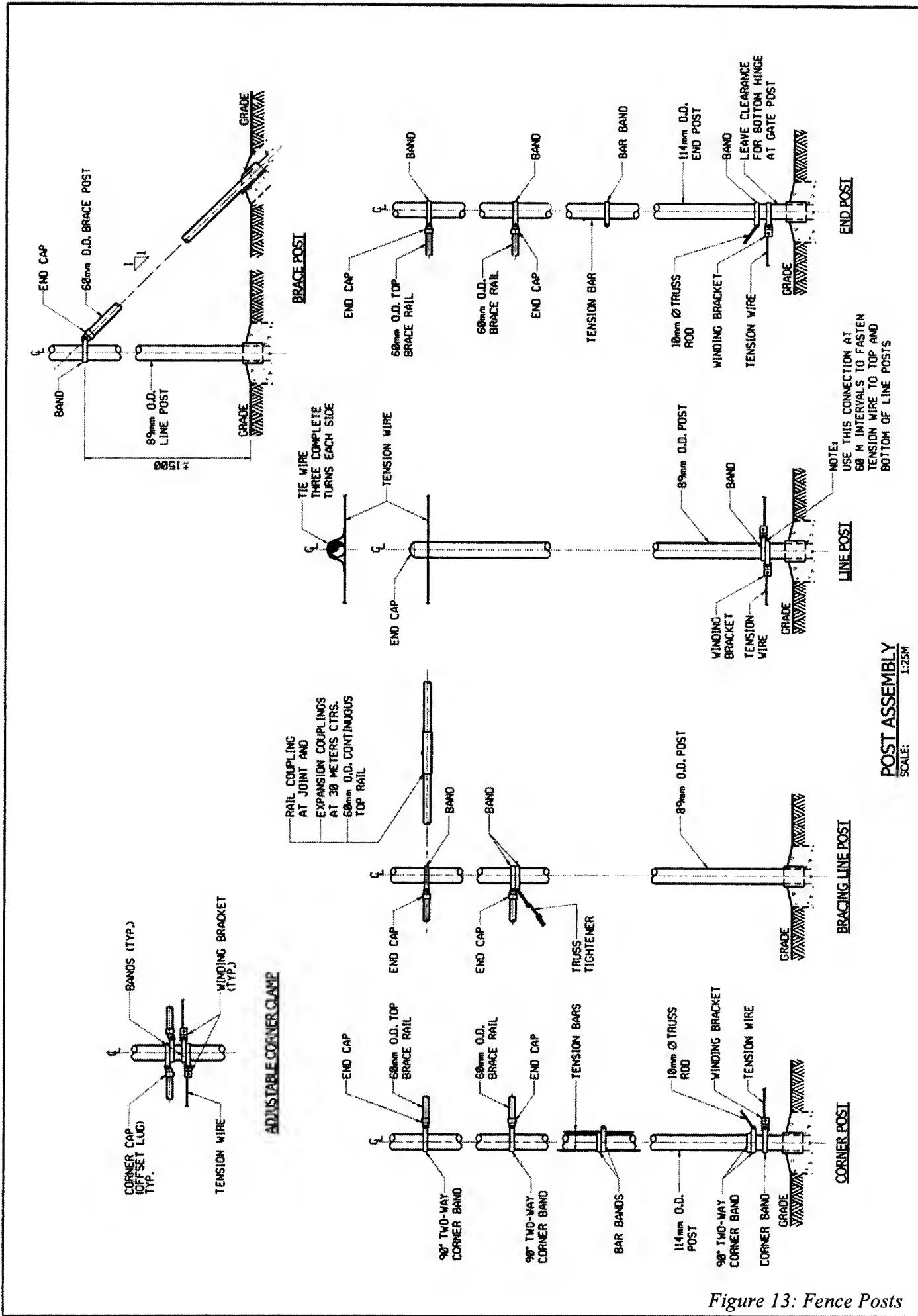


Figure 13: Fence Posts

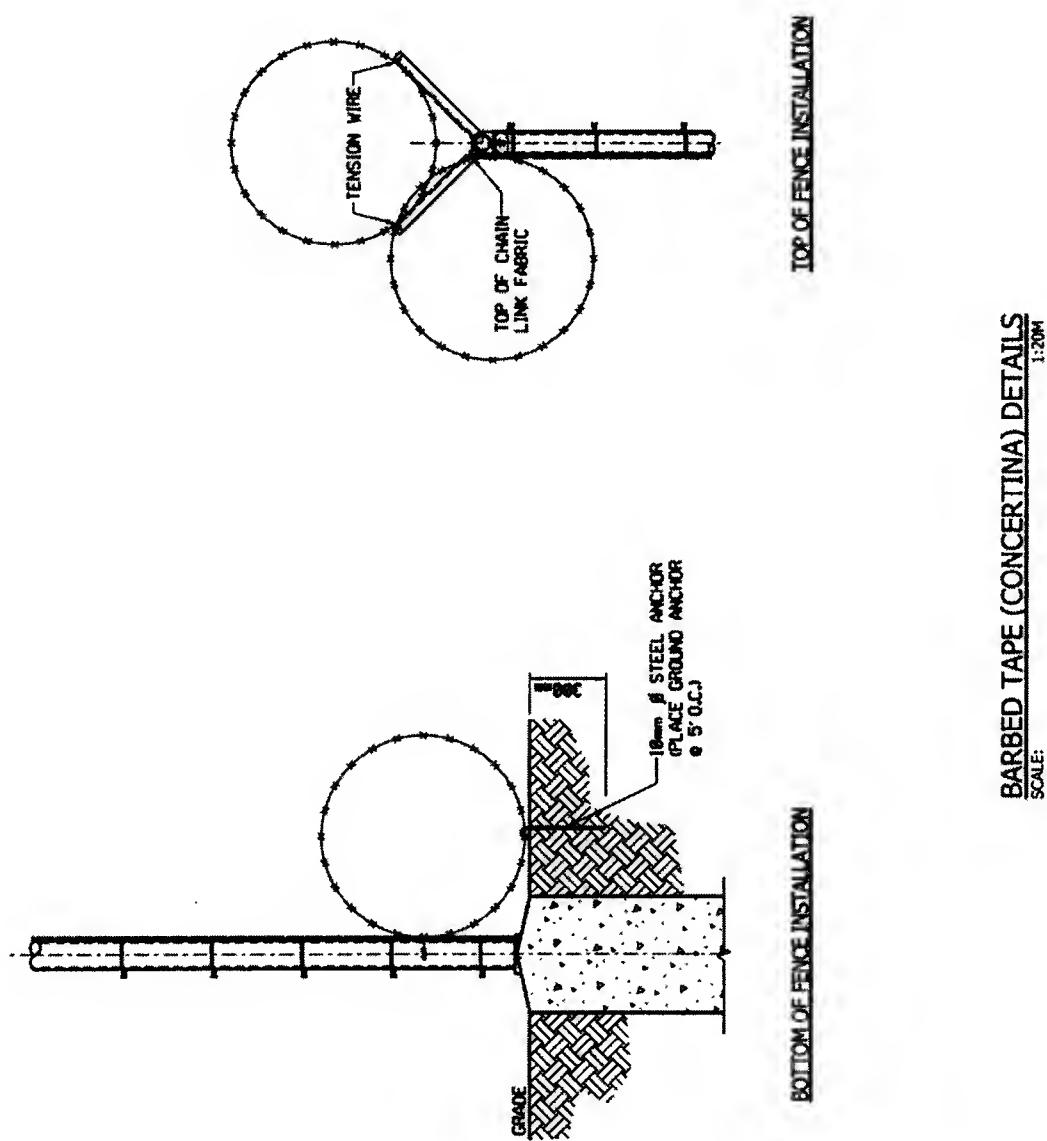


Figure 14: Concertina



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- 4.12.3.2. The line post shall be 3600mm in total length, including length in foundation, unless otherwise stated.
- 4.12.3.3. Line posts shall receive 10 to 12 mils thermal fusion coating of PVC.
- 4.12.3.4. Line Post installation drawings are shown in figures 12 & 13.

4.12.4. Terminal, Corner, and Pull Posts

- 4.12.4.1. Terminal, corner, and pull posts shall be NPS 4 schedule 80 steel pipe (OD = 114 mm [4.5 inch]), high strength 83,000 grade (minimum tensile strength shall be 585 MPa [85,000 psi] and minimum yield strength shall be 572 MPa [83,000 psi]) as per *ASTM F1083* Group 1A, galvanized internally and externally in accordance with Type A of *ASTM 1043*.
- 4.12.4.2. Posts shall receive 10 to 12 mils thermal fusion coating of PVC.
- 4.12.4.3. Line Post installation drawings are shown in figures 12 & 13.

4.12.5. Brace Post

- 4.12.5.1. Brace post shall be NPS 2 schedule 40 steel pipe (OD = 60 mm [2.375 inch]) regular grade as per *ASTM F1083* Group 1A, galvanized internally and externally in accordance with Type A of *ASTM 1043*.
- 4.12.5.2. Brace post shall receive 10- to 15-mils thermal fusion coating of PVC.

4.12.6. Top Rail

- 4.12.6.1. Top rail shall be NPS 2 schedule 40 steel pipe (OD = 60 mm [2.375 inch]), regular grade as per *ASTM F1083* Group 1A, galvanized internally and externally in accordance with Type A of *ASTM 1043*.
- 4.12.6.2. Rails shall receive 10- to 15-mils thermal fusion coating of PVC.



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4.12.7. Tension Wire

- 4.12.7.1. Tension wire shall be a minimum of 7-gage steel, 4.5 mm in diameter in accordance with *ASTM F1664*.
- 4.12.7.2. Tension wire shall be vinyl-coated, class 2b in accordance with *ASTM F934*, to match the same type of coating (PVC Fusion-bonded) specified for the fence fabric.

4.12.8. Barbed Wire

- 4.12.8.1. Barbed wire shall consist of two strands of 12.5-gage galvanized wire according to *ASTM A121*, with 14-gage, 4-point barbs spaced 125 mm.
- 4.12.8.2. Barbed wire shall consist of six rows attached to V-shaped heavy-pressed galvanized arms capable of withstanding 1,112 N (250 pounds) downward pull at the outermost end of the arm without causing permanent deflection of the arm.
- 4.12.8.3. Barbed wire shall be secured to the extension arm by lock wire. Lock wire shall be *ASTM A641*, 360 mm long by 3.75 mm nominal diameter wire, minimum, annealed and galvanized with a 25 mm diameter hook on one end.

4.12.9. Tie Wire

Tie wire shall comply with the requirements for high-security round wire ties specified in *ASTM F626*.

The tie-wire is typically specified in *ASTM F626* as 6-gage or 9-gage wire unless interlocking flat wire ties or power driven fasteners are used in which case the requirements vary. The Operator may select any of the high-security tie wire methods specified in *ASTM F626*.

The tie wire shall be coated with the same type of coating (PVC fusion bonded or extruded) as specified for the fence fabric.



4.12.10. Post Tops

- 4.12.10.1. One post tops shall be provided for each post, with openings to permit through passage of top rail.
- 4.12.10.2. Post tops shall be made of pressed steel designed as a watertight closure cap for tubular posts.
- 4.12.10.3. Tops shall receive 10 to 15 mils thermal fusion coating of PVC.

4.12.11. Fittings

Fittings shall be in accordance with *ASTM F626* with the following specific requirements:

- 4.12.11.1. Tension and brace bands shall be 3.17 mm by 25.4 mm (1/8 inch by 1 in.) secured using 9.5 mm (3/8 in.) galvanized steel carriage bolts and nuts.
- 4.12.11.2. Operator shall use high-security round tie wire, as specified in 4.11.9 above, to secure fence fabric, tension wires and fittings.
- 4.12.11.3. Tension bars shall be 6 mm x 19 mm (0.25 inch x 0.75 inch) galvanized steel in accordance with *ASTM A123*.
- 4.12.11.4. Bands and bars shall receive 10 to 15 mils thermal fusion coating of PVC.
- 4.12.11.5. Drawings of fittings are shown in figure 11.

4.12.12. Brace Rail

- 4.12.12.1. Brace rail shall be NPS 2 schedule 40 steel pipe (OD = 60 mm [2.375 inch] regular grade as per *ASTM F1083* Group 1A, galvanized internally and externally in accordance with Type A of *ASTM 1043*).
- 4.12.12.2. Brace rail shall be equipped with 9.5 mm (0.375 inch) galvanized steel truss rods and truss tighteners in accordance with *ASTM F626*.
- 4.12.12.3. Brace rail, truss rods, and truss tighteners shall receive 10 to 15 mils thermal fusion coating of PVC.



4.12.13. Razor Tape

Razor tape materials and configurations shall be in accordance with *ASTM F1910* with the following specific provisions:

- 4.12.13.1. Razor tape shall be 600 mm diameter (± 50 mm). Each loop shall consist of 24 (± 1) clusters of four needle-sharp barbs on 100 mm centers, each barb measuring a minimum of 30 mm in length.
- 4.12.13.2. The razor tape shall be fabricated from Series 430 stainless steel. The barbed tape shall be permanently cold-clenched over an austenitic mechanical spring core wire.
- 4.12.13.3. The wire shall have a diameter of 2.5 mm with a minimum tensile strength of 965 kN/m² (140 psi). The razor tape shall have a minimum 230° wrap about the core wire.
- 4.12.13.4. Adjacent alternate loops shall be clipped together in five (5) locations around the circumference to obtain the concertina effect.
- 4.12.13.5. Clip spacing of the extended coil shall be 300 \pm 50mm. Clips shall be capable of withstanding a minimum pull load of 900 N (200 lbs). Each coil shall contain 51 loops and cover 7.5m.
- 4.12.13.6. Where razor tape is placed on the ground, each coil shall be anchored to the ground at 1.5 meter intervals using anchors formed from 10 mm diameter reinforcement bars. Each reinforcement bar anchor shall have a 50 mm hook formed at the top and shall be driven a minimum of 300 mm into the ground.
- 4.12.13.7. Razor Tape drawings are shown in figure 14.

4.12.14. Concrete

- 4.12.14.1. Concrete shall have a minimum 28-day compressive strength of 28 MPa (4000 psi).
- 4.12.14.2. The maximum aggregate size shall be 25 mm (1 inch).



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4.12.14.3. The maximum slump shall be 75 mm (3 inch), and entrained air shall be between 2 percent and 4 percent.

4.12.14.4. Concrete mix design shall be in accordance with *ASTM C94*.

4.12.14.5. Cement shall be type V sulfate resistant.

4.13. Installation

The fence shall be installed in accordance with *ASTM F567* and the specific provisions in this section. Section 5.0 of this security directive contains drawings of installation requirements.

4.13.1. Fabric

4.13.1.1. The fencing fabric shall be attached to all line posts by means of tie wire spaced at intervals not exceeding 350 mm along each post. Fasten the fabric to the rail or tension wire at intervals not exceeding 600 mm.

4.13.1.2. The chain link fence fabric shall be installed so that the posts are enclosed.

4.13.1.3. The bottom of the chain link fabric shall be tied to a continuous concrete anchor constructed according to Figure 2.

4.13.1.4. Tension bars shall be used with fabric bands spaced at maximum 375 mm intervals to fasten fabric to line posts.

4.13.1.5. The bottom edge of fabric shall be fastened to the tension wire with wire ties at intervals not exceeding 12 inches (250 mm).

4.13.1.6. The fabric shall be stretched tautly so as not to deflect more than 76 mm (3 inch) in the center of the fence panel in between the two line posts. Fabric shall be fastened securely to the posts.

4.13.2. Posts

4.13.2.1. Where solid rock is encountered, posts shall extend 600 mm into concrete footings.

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- 4.13.2.2. All posts, except brace posts, shall be installed in a vertical position, plumb and in line.
- 4.13.2.3. Footings for all posts shall extend 100 mm below the end of the post.
- 4.13.2.4. The soil shall be moistened before placing the concrete.
- 4.13.2.5. All line posts shall be equally spaced at intervals of not more than 3 m.
- 4.13.2.6. Terminal posts (Corner, End, Gate or Pull) shall be installed at the beginning and end and at a maximum of 90 m intervals of fence fabric and at changes in vertical and horizontal alignments exceeding 22½° deflection angle.
- 4.13.2.7. Except for gateposts, the exposed surface of the concrete foundation shall be set 25 mm above surrounding grade with a smooth 13 mm crown, sloping away from the post.
- 4.13.2.8. Before placing components such as fabric, rails, tension wire, and gates, the concrete shall have cured a minimum of 7 days unless the concrete reaches at least 75 percent of its design strength.
- 4.13.2.9. Line, corner, pull, and terminal posts shall be set vertically in cylindrical concrete foundations in accordance with Table 2.

Comment:

The values in Table 2 below are the minimum; site soil conditions may require a bigger size in diameter, depth, or embedment.

Table 2– Post Installation Schedule

| Post Type | Foundation Diameter (mm) | Foundation Depth (m) | Post Embedment (m) |
|-------------------------------|--------------------------|----------------------|--------------------|
| Fence Post | | | |
| Line Post | 350 | 1.0 | 0.9 |
| Corner, Pull & Terminal Posts | 450 | 1.1 | 1.0 |
| Brace Post | 300 | 1.0 | 0.9 |
| Gatepost OD (mm) | | | |

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| Post Type | Foundation Diameter (mm) | Foundation Depth (m) | Post (m) | Embedment |
|-----------|--------------------------|----------------------|----------|-----------|
| 73 | 300 | 1 | 0.9 | |
| 168 | 600 | 1.2 | 1.1 | |
| 219 | 800 | 1.5 | 1.4 | |

- 4.13.2.10. All posts shall be supplied with the necessary holes drilled for the appropriate fittings.
- 4.13.2.11. Barbed arms shall be riveted or bolted to the post.
- 4.13.2.12. Brace posts shall be attached at a point 1500 mm above ground level and extend downward toward the inside of the fence at 45° in a vertical plane which is perpendicular to the plane of the fence.
- 4.13.2.13. Pull post intervals shall not exceed 90 m (300 ft).
- 4.13.2.14. Anchor post installation details are shown in figures 12 & 13.

4.13.3. Top Rail and Tension Wire

- 4.13.3.1. Fence shall be installed with a top rail and bottom tension wire.
- 4.13.3.2. The top rail shall be continuous except over drive gates. One expansion/contraction coupling shall be used for every 30 m of rail.
- 4.13.3.3. If it is necessary for a top rail to be omitted, a top tension wire shall be installed.
- 4.13.3.4. The tension wire shall be secured to the chain link fabric with high-security round tie wire, as specified in 4.11.9 above, spaced no greater than 305 mm (12 in) on center.
- 4.13.3.5. Tension wire shall be secured to terminal posts by means of a winding bracket.

4.13.4. Bracing in Plane of Fence

- 4.13.4.1. Each brace assembly shall consist of one top and one intermediate compression member both of 60 mm O.D. pipe and one adjustable diagonal tension rod of 9.5 mm diameter.



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The top rail is the top compression member. Pipe used for the compression members shall be of one piece without couplings in the bracing panel.

- 4.13.4.2. Gate and end posts shall be braced to the nearest line post with one complete brace assembly.
- 4.13.4.3. Corner and pull posts shall be braced to the two nearest line posts with one complete brace assembly to each line post.

4.13.5. Barbed Wire

- 4.13.5.1. Six strands of barbed wire shall be installed.
- 4.13.5.2. Strands shall be spaced uniformly and attached to frame with bands, clips, or eyebolts.
- 4.13.5.3. The strands of barbed wire shall be stretched to remove sag and be anchored firmly to extension arms.

4.13.6. Miscellaneous Installation

- 4.13.6.1. The tie wires shall clasp the pipe and fabric firmly with ends twisted at least two full turns.
- 4.13.6.2. Coatings damaged in the field shall be repaired using methods and techniques recommended by the manufacturer.
- 4.13.6.3. Posts and rails shall be one piece free of welded sections.
- 4.13.6.4. Installation of barbed tape shall follow the practice of *ASTM F1911*.

4.13.7. Alignment

- 4.13.7.1. Fence shall run in straight lines as far as possible. Where changes of direction are required the angle shall not be less than 90 degrees.
- 4.13.7.2. When fully constructed the barbed wire, tension wire, fabric, and truss rods shall be stretched tautly.



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4.13.7.3. Where the fence crosses features such as streams and drainage ditches and where conforming of the fence to the ground contour is impractical, the fence shall span the depression.

The space below the bottom of the fence shall be closed with extra fence fabric or barbed wire. If extra length fence posts are required at such locations, they shall be furnished and installed in lieu of standard length posts, together with any intermediate posts, stakes, braces, extra fabric, or wire as may be required.

4.13.7.4. A reasonably smooth profile at the fence line shall be provided. The bottom of the fence shall not be more than 25 mm (1 inch) above the finished ground line.

4.13.8. Grounding

4.13.8.1. Fences which are within 10 m of an enclosed ground grid or ground loop that is connected to equipment operated at 1000 V or greater shall not be PVC coated and shall be grounded at intervals not exceeding 15 m to the ground grid or loop. All fences within 3 meters of a ground grid or ground electrode shall be bonded at the nearest fence post to the ground grid or ground electrode.

4.13.8.2. Fences that pass under a transmission line operating at 69 kV and above shall not be PVC coated and be grounded at intervals not exceeding 15 m on that portion of the fence within 100 m of the power line.

4.13.8.3. Fences that cross over a ground grid or conductors that connect two ground grids shall not be PVC coated and shall have a bond between the grid or conductors and the nearest post. If the crossing area is extensive, the bond is required every 50 m.

Exception:

If the ground conductors used to connect the ground grids are insulated and sleeved with PVC conduit at points within 10 m of the fence, then the bond is not required.

4.13.9. Gates



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- 4.13.9.1. Gates shall be installed in accordance with the locations, type, and size specified in the design.
- 4.13.9.2. Gates shall be furnished with necessary fittings and hardware.
- 4.13.9.3. Gates shall be installed plumb, level, and secure for the full opening without interference.
- 4.13.9.4. Ground items shall be set in concrete in accordance with gate manufacturer's recommendations.
- 4.13.9.5. Parts and attachments shall be inspected for defects.

4.13.10. Quality Assurance

- 4.13.10.1. The supplier shall be solely responsible for quality control of all furnished materials, installations, and workmanship, including those items or installations furnished by any of the supplier's subcontractors or vendors.
- 4.13.10.2. The purchaser reserves the right to make inspections at any time during the receipt and installation of fencing materials.

4.14. Fence Penetration

Fence penetration by pipelines shall be either under or over the fence and shall comply with any of the following approved methods.

4.14.1. Under Fence Penetration

- 4.14.1.1. The pipeline shall be buried at least 18m on either side of the fence for Category 1, 2 & 3. Where fence design configuration requires greater distances, the pipeline shall be buried outside those clearances. For Category 4 fences, the distance at which the pipeline is buried is at Operator discretion.
- 4.14.1.2. Under Fence penetration shall be carried out by direct burial for all fence Classifications.



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- 4.14.1.3. Direct Burial requires that the pipeline be buried to a depth compliant with applicable codes but, in no case, less than 1.5m deep.
- 4.14.1.4. Under fence penetrations shall require the construction of a concrete culvert above/at/below ground level with opening(s) for the pipeline. The opening shall be sealed on both sides with bars and a collar to prevent ingress of humans or small animals. Maximum open space between the bars/grates shall be less than 620cm² (approximately 20cmX30cm). The bars/grates shall have sensors installed to detect tamper/breach attempts. The bars and collar and fence shall conform to the culvert shape.
- 4.14.1.5. Stout guardrails shall be installed at the transition point where the pipeline enters/exits the ground to prevent vehicle damage to the pipeline.
- 4.14.1.6. A dedicated camera augmented with a sensor shall be provided that will permit video monitoring and automatic alarm annunciation in the local SCC of an intrusion attempt of the pipeline/collar.

4.14.2. Over Fence Penetration

- 4.14.2.1. Over fence penetrations shall be at least 7m above the ground plane for Category 1, 2 & 3 fences. Category 4 fence height clearances shall be at Operator discretion.
- 4.14.2.2. No exposed pipe less than 7m above the fence shall be permitted within 18m on either side of the Category 1, 2 or 3 fence.

Where fence design configuration requires greater distances, the pipeline shall be buried outside those clearances.

For Category 4 fences, the distance at which the pipeline is buried are at Operator discretion.

- 4.14.2.3. For Category 1, 2 & 3 fencing systems the pipeline on exterior side of fence, and 5m on the inside of the fence, shall be



covered with concertina wire, installed the same way as the top of a Category 1 fence. The concertina shall terminate 2m before ground entry on the exterior side of the fence.

For Category 4 fencing systems pipeline on both the interior, and exterior, side of the fence shall be covered with concertina wire for a distance of 5m centered on the fence.

- 4.14.2.4. Stout guardrails shall be installed at the transition point where the pipeline enters/exits the ground to prevent vehicle damage to the pipeline.
- 4.14.2.5. Operator shall ensure that fence sensors are not affected by the pipeline.
- 4.14.2.6. A dedicated camera shall be provided that will permit video monitoring of the pipeline/collar in the local SCC.



5.0. Application of Requirements

This section lists how the elements of this security directive apply to facilities depending on their classification using the criteria stated in section 4.2 of SEC-01.

| ELEMENT | APPLICATION | | | |
|---|-------------|---------|---------|---------|
| | Class 1 | Class 2 | Class 3 | Class 4 |
| Category 1 Fencing | ✓ | | | |
| Category 2 Fencing | | ✓ | | |
| Category 3 Fencing | | | ✓ | |
| Category 4 Fencing | | | | ✓ |
| Shared Fencing between Adjacent Facilities | ✓ | ✓ | ✓ | |
| Outer Property Fence | ✓ | ✓ | ✓ | |
| Clearances - General | ✓ | ✓ | ✓ | |
| Main Gates | ✓ | ✓ | ✓ | ✓ |
| Emergency / Heavy Equipment Gates | ✓ | ✓ | ✓ | |
| Design Requirements for Fencing System Components | ✓ | ✓ | ✓ | ✓ |
| Installation | ✓ | ✓ | ✓ | ✓ |
| Fence Penetration | ✓ | ✓ | ✓ | |